ERRORS IN SHOOTING JUDGMENT AND PERFORMANCE BY LAW ENFORCEMENT PERSONNEL DURING A STRESSFUL TRAINING SCENARIO

James L. Meyerhoff, George A. Saviolakis, and Bob Burge
Dept. of Applied Neurobiology, Div. Neuroscience, Walter Reed Army Institute of Research, Silver Spring, MD 20910.

William Norris, Terry Wollert, and Valerie Atkins
Federal Law Enforcement Training Center (FLETC), Glynco, GA.

Charles D. Spielberger
Dept. of Psychology, University of South Florida, Tampa, FL.

1. ABSTRACT

Police trainees who were ready to graduate from the Federal Law Enforcement Training Center (FLETC) volunteered to participate in an exercise designed to evaluate their survivability. In a highly stressful interactive scenario, which included a hostage situation during a staged domestic dispute, performance was evaluated for a range of responses, including: weapon malfunction, shooting judgment and accuracy, communications, and emotional reactions. Nineteen percent of subjects shot the hostage, a failure rate that falls in the reported range of friendly fire casualties in military combat. The Spielberger Trait Anger Scale showed an association with shot placement and performance during the gunfight, as well as with overall performance scores.

2. INTRODUCTION

Soldiers during military operations in urban terrain (MOUT) or in peacekeeping/policing actions are often faced with "Shoot/no shoot" decisions. These decisions must be made in fractions of a second, and have profound consequences. A wrong decision can lead to death of the soldier, death of a comrade, collateral damage or errors in shooting judgment, including a "friendly fire" incident. Authors agree that the most important factor in fratricide is "human inability to cope with the stressors of the battlefield" (Shrader, 1992; Steinweg, 1995).

Civilian Law enforcement officers are often faced with similar challenges and stressors. From 1989 through 1998, 682 police officers were killed in the line of duty in the USA. In addition to interpersonal skills and sound judgment, tactical skills required include vigilance, continuous assessment of threat level, and if threat escalation occurs, a capability for rapid change of tactics to include force, if indicated. Situations associated with high levels of risk include domestic violence investigations, traffic stops and executing search or arrest warrants.

Exposure to environmental stressors stimulates increases in heart rate (HR) and blood pressure (BP) as well as secretion of a variety of hormones. In general, these hormones enable the body to support successful behavioral coping responses [e.g., "fight or flight reaction"] (Cannon, 1929; reviewed in Mason, 1968; Meyerhoff et al., 1988, 1990, 2000). Cortisol is released into the bloodstream from the cortex of the adrenal gland, and is one of several hormones that increase blood glucose as part of the normal response to exertion or psychological stress. Although moderate increases in arousal may enhance performance, extremely high levels may impair it (Yerkes and Dodson, 1908).

In this study, we evaluated the effect of stress on performance of a variety of skills during the course of a realistic and complex scenario, using volunteers recruited from the FLETC officer training courses. Salivary cortisol was measured as the hormonal stress marker, since saliva is easily collected and changes in salivary levels reflect changes in plasma concentrations (Kirschbaum et al., 1992). In addition, we monitored HR and BP throughout and assessed multiple psychometric dimensions before and after completion of the scenario. These indices of arousal in response to the environmental stressor were compared with the scores in individual tasks and with a composite score.

3. EXPERIMENTAL PARADIGM

The scenario of the FLETC was designed to test the capacity of students to draw on their training and personal resources to "survive" in a novel, rapidly evolving, highly stressful, multi-task paradigm that realistically models lethal force situations often encountered in the line of duty. Under a WRAIR IRB-approved protocol, 90 police trainees who had completed all coursework and were ready to graduate from FLETC were recruited and enrolled in the study after giving their written, informed consent. Students were then

Report Documentation Page	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE **00 DEC 2004**	2. REPORT TYPE **N/A**	3. DATES COVERED **-**
4. TITLE AND SUBTITLE **Errors In Shooting Judgment And Performance By Law Enforcement Personnel During A Stressful Training Scenario**		5a. CONTRACT NUMBER
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Dept. of Applied Neurobiology, Div. Neuroscience, Walter Reed Army Institute of Research, Silver Spring, MD 20910; Federal Law Enforcement Training Center (FLETC), Glynco, GA.**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release, distribution unlimited**		
13. SUPPLEMENTARY NOTES **See also ADM001736, Proceedings for the Army Science Conference (24th) Held on 29 November - 2 December 2005 in Orlando, Florida., The original document contains color images.**		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT **UU**	18. NUMBER OF PAGES **6**	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**			

instrumented with HR and BP monitoring (Accutracker) equipment. HR and BP were automatically recorded frequently during the scenario.

One week before the scenario, a pre-baseline sample was taken for salivary cortisol. On the day of the scenario, during a baseline period, students were seated and were given the State-Trait Personality Inventory (STPI). This self-report psychometric questionnaire, developed by Spielberger (1983), has been extensively validated and is widely utilized. The STPI State Anxiety asks subjects to endorse feelings ranging from calm, to terror. State Anger scale asks subjects to endorse feelings ranging from mild irritation to fury and rage. Trait Anger is defined as the frequency that state anger is experienced over time. Individuals with high scores for Trait Anger experience a wider range of situations as anger provoking. After the psychometric tests were completed, salivary samples were taken for subsequent analysis of salivary levels of cortisol by radioimmunoassay.

After the baseline period, students were studied in a driving paradigm. Students were paired with a confederate of the experimenters (introduced as "another student" who would serve as their duty "partner") and the two were evaluated for routine driving skills. Then the two were evaluated for their performance during an emergency high-speed driving task. After performing first as the driver, while the partner was a passenger, the student was then required to move to the passenger seat and respond to incoming radio communications while the partner drove the test course. The partner (who was actually a driving instructor) rendered a convincing performance of driving erratically, appearing to lose control while taking a turn at high speed, putting the car into a spin and going off the road.

The student then received a radio call from a dispatcher instructing them to proceed with flashing lights and siren to an address to investigate a domestic complaint. Arriving at the address, a sergeant instructed them to enter the house and take a report from a complainant who claimed that his roommate had stolen a large sum of money from him. The student and the partner were given white protective vests and face shields, which they had previously used in interactive firefights with 9mm simunitions (rounds which propel paint capsules). They were also given 9mm semi-automatic pistols modified to fire simunitions, and three 10-round magazines of ammunition. The simunitions rounds were color-coded for the two weapons, so that shooting results could be determined by subsequent visual inspection of the protective vests.

Two instructors, unarmed but also wearing protective gear, were inside the house and served as role players – one as a co-operative "complainant", the other as "suspect". When the student and partner entered the residence, the complainant was seated in the living room and they began taking a report from him. After a few minutes, the "suspect" emerged from a back room. A shouting match between the complainant and the suspect erupted and began to escalate. The partner approached the suspect carelessly and had his holstered 9mm weapon taken away by the suspect. The suspect promptly shot the partner, who staggered and fell, blocking the door that would have provided the only acceptable exit. The suspect took the complainant hostage, holding him to the side for two seconds, thereby presenting himself briefly as a target, before pulling the hostage squarely in front of himself, and backing behind a brick wall. The suspect then shot the complainant with the partner's 9mm weapon, again ducked behind the wall, re-emerging with a shotgun with which he began firing at the student, who had minimal cover available.

The suspect then resumed firing at the student with the 9mm handgun. All shots were exchanged between the suspect and the student within 10 feet of each other, thus considered close quarters combat. The third round in the student's weapon was a "dud" that failed to fire. This required the student to perform immediate action to clear the malfunction. Many students improperly resorted to inserting a spare magazine. After several minutes of exchanging fire, the suspect terminated this phase of the scenario by falling to the floor, immobile, allowing his weapon to slide a few feet away from him. The student was expected to maintain cover of the downed suspect while recovering the suspect's weapon and making it safe.

The shooting was followed by an internal affairs (IA) investigation, conducted in a separate room by a role player dressed in civilian clothes. This provided a post-shooting period during which the student was seated at a table and given "official" police forms to fill out related to the IA investigation, and the Spielberger State Anxiety and Anger questionnaires were again administered. After the psychometric tests were completed, the student was questioned about various elements of his or her performance, including shot placement, the regulations covering the use of lethal force, as well as the rationale and the timing of the decision to draw the weapon and fire. One salivary sample was taken after the IA interview and another taken 30 minutes later, after subject debriefing at termination of the experiment, to be used for subsequent cortisol analysis.

4. RESULTS

Students' performances were scored on the following elements of performance: driving,

communications, response to weapon malfunction, shooting judgment and accuracy, as well as post-shooting recall. Many of these elements were scored on a pass or fail basis, and the terms "go" or "no go" are customarily used by the instructors at FLETC. For example, if a student shot the hostage, that was rated a "no go".

Serious failures were observed in many of these performance areas. In the emergency driving test, immediately after the partner appeared to lose control of the car, an incoming radio call from the dispatcher was received. Over 60% of students failed to respond to the radio call within the criterion time period of 8 seconds. Fifty-seven percent failed to accurately describe the nature of the call (officer needs assistance) to the partner. Ninety-five percent failed to follow doctrine requiring that they form a plan before any investigation (e.g., who will be contact officer and which one will be cover officer).

During the investigation of the domestic complaint, 19% of students shot the hostage (Fig. 1). Moreover, 97% failed to meet the criterion of 70% of their rounds hitting the suspect (Fig. 2). Many of the students fired blindly, from the minimal cover available. Trainees were expected to call for backup in high-risk situations and had also been taught that if using their radio while their weapon was in their hand, the weapon should be kept in the dominant hand. Seventy percent failed this element by switching the weapon to the weak hand, in order to operate the radio in the dominant hand. The approved response for coping with the "dud" round that fails to fire is to tap the magazine, rack the slide and re-engage the threat. The majority of the students failed this element, resorting to a variety of methods, all less desirable, to clear the malfunction (Fig. 3). During the IA investigation, only 43% of students could accurately describe their shot placement (Fig. 4), and only 57% could accurately identify the exact moment when the situation and doctrine first justified the use of lethal force.
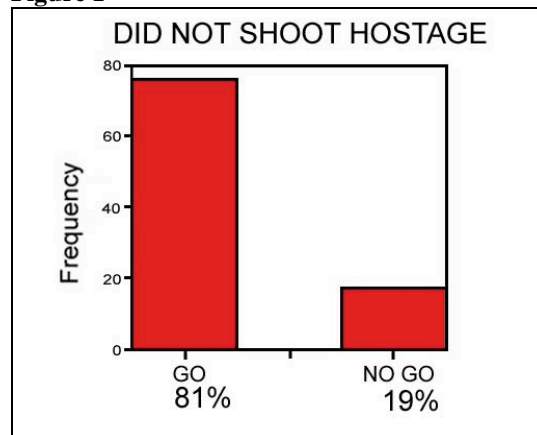
Figure 1

Fig. 1. 19% of subjects shot the hostage
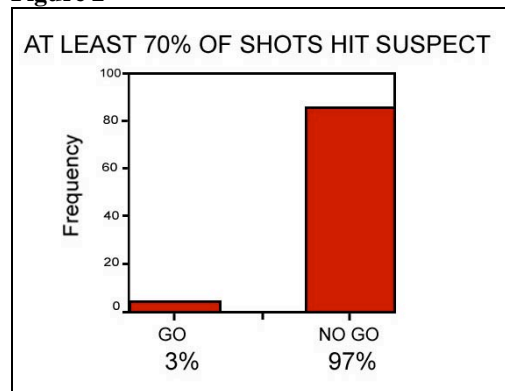
Figure 2

Fig. 2. Only 3% of students met the criterion of 70% of their fired rounds hitting the suspect.
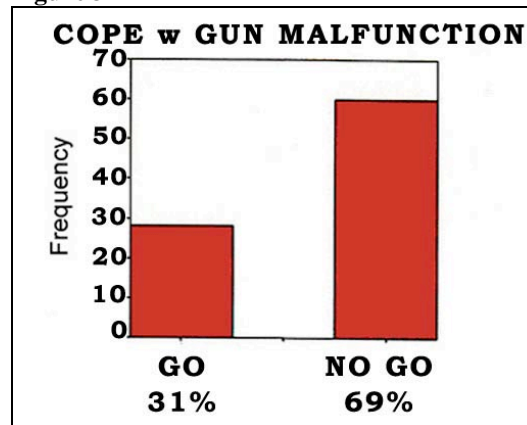
Figure 3

Fig 3. Only 31 % of students properly coped with the 9mm weapon malfunction.
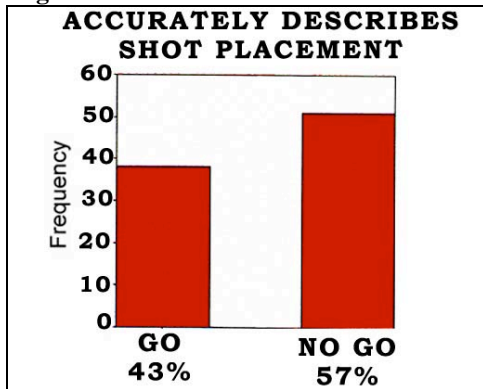
3

Figure 4

Fig. 4. During the IA investigation, only 43% of students could articulate where their shots had been placed.

Figure 5

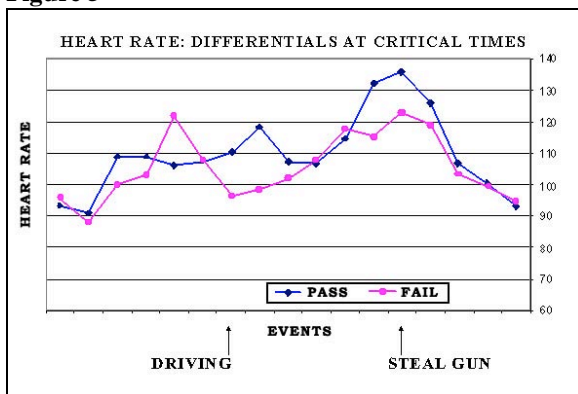

Fig. 5. Students receiving passing scores during partner's erratic driving and during gunfight had higher heart rates during those events.
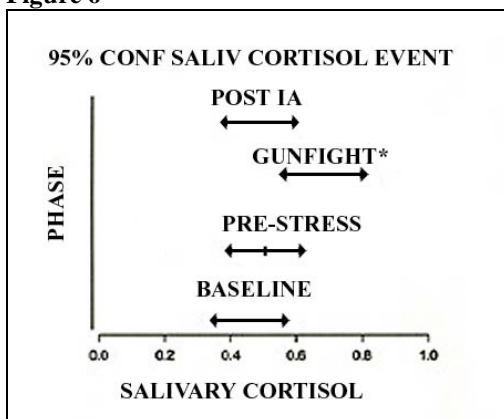
Figure 6

Fig. 6. Salivary cortisol levels were significantly elevated after the gunfight (Dunnett's test, p < 0.013)

Significant elevations in HR and BP were observed during the scenario. Moreover, differences in heart rate (HR) responsivity were observed during two events, between students who achieved passing scores on those events vs. those that failed. Whereas successful students displayed additional HR acceleration while in the passenger role during the "erratic driver" episode [t-test = 3.317, d.f. = 95, p < 0.013] as well as during the gunfight [t-test = 2.429, d.f. = 93, p < 0.017], students who received failing scores on those elements had lower heart rates than successful students (Fig. 5).

Salivary cortisol levels were significantly higher after the gunfight, compared to baseline [Dunnett's test, p < 0.013] (Fig. 6), suggesting increased arousal. Changes in the State Anxiety and State Anger scores during the scenario were particularly interesting and were significantly elevated after the gunfight, compared to baseline [respective pair wise comparisons by t-tests: t = 15.3, df = 92, p < .001; t = 8.6, df = 88, p < .001]. These two measures did not differ, however, between students receiving passing vs. failing scores on those events.

The Trait Anger score showed an interesting modest association with the shot placement score (r = .27) as well as with overall performance score [r = .32]. This is consistent with the association found between Trait Anger Score and performance during the gunfight [Pearson Chi Square = 2.96, df = 1, p = .086]

5. DISCUSSION

One definition of stress is the perception that situational demand exceeds resources (Saunders et al., 1996). In the present study, the student relies on the partner as a resource during the investigation of the domestic dispute. Law enforcement officers are routinely assigned to work in pairs and normally expect to rely on their duty partner. The partner demonstrated incompetence, first as a driver and then in failing to protect his weapon during the domestic dispute. Thus, in the FLETC scenario, the shortcomings of the partner constituted a significant deficit in resources and a major stressor for the student.

Stress has been cited as a major factor in errors in shooting judgment (Shrader, 1992; Steinweg, 1995). Friendly fire was responsible for 24% of U.S. forces killed in action (KIA) and 15% of wounded in action (WIA) casualties in Operation Desert Storm (Steinweg, 1995). Thus, the percent of students shooting the hostage (19%) falls in the range of reported incidence of friendly fire casualties in military combat. Errors were prevalent not only in performance, but in post-shooting recall, as over 50% of students could not accurately recall their shot placement. As reported in the instance of friendly fire, psychological stress may be an important factor in

4

the errors in shooting judgment and other elements of performance seen in the present study.

The relationship between arousal and performance has been described as an inverted U-shaped curve (Yerkes and Dodson, 1908). In the present study, significant elevations in salivary cortisol levels were noted after the shooting episode. The administration of exogenous glucocorticoids has an inverted U-shaped effect on memory (Lupien & McEwen, 1997). Low doses increase arousal, whereas high doses are reported to induce hyperarousal, decreased use of relevant cues and impairment of cognitive performance (de Quervain et al., 2000).

Stress-induced increases in endogenous cortisol levels have also been associated with decrement in performance on a memory task (Kirschbaum et al., 1996). In the present study, there were dramatic examples of decrements in many aspects of performance, from threat perception and weapons handling to timeliness in responding to dispatcher. Although the elevated levels of glucocorticoids may have interfered with memory, cortisol levels did not predict overall performance.

Students who performed successfully during particularly challenging events had higher heart rates during those challenges than students that failed those events. This raises several questions including the possibility that those who failed the scenario were insufficiently reactive, or had a significantly higher degree of vagal tone. Accordingly future studies should include measurement of heart rate variability.

State Anxiety and State Anger were significantly elevated during the scenario, and suggest that subjects had a notable degree of emotional arousal during the scenario. Trait Anger was also an interesting metric with a degree of association with shot placement and performance during the gunfight, as well as with overall performance scores. The Trait Anger Scale includes two subscales: Angry Temperament, a disposition to frequently experience anger independent of circumstances; and Angry Reaction, a tendency to react with anger in situations that involve frustration and being treated badly (Spielberger et al., 1995). It will be important to determine the relative contributions of each of these factors to performance outcome.

Stress inoculation training has been shown to improve performance (Saunders et al., 1996). If the stress levels are graduated, confidence and skills may be acquired simultaneously (Keinan, et al, 1996). It is suggested that scenario-based exercises might be introduced earlier in training, with initial stress levels moderate and increased with experience.

6. CONCLUSIONS

FLETC staff recommend that high-stress scenario-based exercises should be introduced earlier and more frequently in training to improve officer capability to adapt to rapidly changing, unpredictable situations. Future studies should include measures of heart rate variability.

7. ACKNOWLEDGEMENTS

8. REFERENCES

Cannon, W.B. 1929: Bodily changes in pain, hunger, fear and rage. Appleton, New York.

DeQuervain DJ-F, Roozendall, B., Nitsch, R., McGaugh, J. and Hock, C. 2000: Acute cortisone administration impairs retrieval of long-term declarative memory in humans. Nature Neuroscience, 3(4):313-314.

Keinan, G. and Friedland, N. 1996: Training effective performance under stress: queries, dilemmas, and possible solutions. In J.E. Driskell & E. Salas (Eds.) Stress and human performance. (pp. 257-277) Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.

Kirschbaum, C., Wolf, O., May, M., Wippich, W. and Hellhammer, D. 1996: Stress- and treatment-induced elevations of cortisol levels associated with impaired declarative memory in healthy adults. Life Sciences, 58(17), 1475-1483.

Lupien, S and McEwen, B. 1997: The acute effects of corticosteroids on cognition: integration of animal and human studies. Brain Research Reviews 24,1-27.

Mason, J.W. 1968: Over-all hormonal balance as a key to endocrine organization. Psychosomatic Medicine 30: 791-808.

Meyerhoff, J. L., Oleshansky, M.A,, & Mougey, E.H. 1988: Psychological stress increases plasma levels of prolactin, cortisol and POMC-derived peptides in man. Psychosom. Med. 50 (3), 295-303.

Meyerhoff, J. L., Oleshansky, M. A., Kalogeras, K. T., Mougey, E. H., Chrousos, G. P., & Granger, L.G.

1990: Responses to emotional stress: possible interactions between circulating factors and anterior pituitary hormone release. In J.C. Porter & D. Jezova, (eds.) <u>Circulating Regulatory Factors and Neuroendocrine Function: Advances in Experimental Biology and Medicine.</u> (pp. 91-111). New York:Plenum Press.

Meyerhoff, J.L., M.A. Hebert, K.L. Huhman, E.H. Mougey, M.A.Oleshansky, M. Potegal, G.A. Saviolakis, D.L. Yourick and B.N. Bunnell. 2000: Operational stress and combat stress reaction: neurobiological approaches towards improving assessment of risk and enhancing intervention. In Karl Friedl, Harris Lieberman, Donna Ryan and George Bray (eds). <u>Countermeasures for Battlefield Stressors; Pennington Nutrition Series, vol. 10</u> Baton Rouge: Louisiana University Press.

Saunders, T., Driskell, J.E., Johnston, J.H. and Salas, E. 1996: the effect of stress inoculation training on anxiety and performance. J. Occup. Health Psychol. 1(2), 170-186.

Selye, Hans (936: <u>The stress of life.</u> New York: McGraw-Hill Companies.

Shrader, C.R. Friendly fire: the inevitable price. Parameters. Autumn 1992, pp. 29-44.

Spielberger, C. D., Jacobs, G. Russell, S., & Crane, R. 1983:. Assessment of anger, the State-Trait Anger Scale. In J.N. Butcher and C.D. Spielberger (Eds.) <u>Advances in personality assessment (Vol. 2, pp. 159-187).</u> Hillsdale, NJ: Lawrence Erlbaum Associates.

Spielberger, C. D., Reheiser, E.C., and Sydeman, S.J. 1995: Measuring the experience, expression, and control of anger. In H. Kassinove (Ed.) <u>Anger disorders: definitions, diagnosis, and treatment</u>. Washington, D.C.: Taylor & Francis.

Spielberger, C. D., Sydeman, S.J., Owen, A.E., and Marsh, B.J. 1999: Measuring anxiety and anger with the State-Trait Anxiety Inventory (STAI) and the State-Trait Expression Inventory (STAXI). In M.E. Maruish (Ed.) <u>The use of psychological testing for treatment planning an outcomes assessment (2nd ed.)</u> Mahwah: Lawrence Erlbaum Associates.

Steinweg, K.K. Dealing realistically with fratricide. Parameters. Spring, 1995. pp. 4-29.

Yerkes, R.M. and Dodson, J.D. 1908: The relation of strength of stimulus to rapidity of habit-formation. J. Comp. Neur. Psychol. 18, 459-482.